Science Panel Coordination Meeting - Review of Project 5

ATTENDEES: Bill Adams, Theresa Presser, Joe Skorupa, Bill Wuerthele, Bill Moellmer, Theron Miller, Jodi Gardberg, Martin Grosell, Harry Ohlendorf, Bruce Waddell, Nathan Darnall, Jeff DenBleyker

FROM: Jeff DenBleyker

DATE: January 10, 2008

The objective of this conference call was to review comments regarding Martin Grosell's final report for Project 5 – Brine Shrimp Kinetics Study. Below is a summary of key discussion.

Bill Adams started the discussion with a review of some of the questions he originally posed to the Science Panel on November 30, 2007. He noted that brine shrimp were cultured in a stock solution without Se added but that it is reasonable to assume that the brine shrimp had an initial concentration of Se or they would be Se deficient. We do not know what the starting concentration of Se is before they are placed into the Se-75 solution. Measurement of Se-75 is accurate but it doesn't account for accumulation of non-radioactive Se. We have the same potential issue in measuring depuration constants.

Martin Grosell said that it is assumed that non-radioactive and radioactive Se are in equilibrium. This is a realistic assumption but is not known with absolute certainty. However, the uptake constant is independent of the starting concentration, so the uptake rates he calculated would not be affected. There was agreement with this comment. Martin pointed out that uncertainty does lie in how the different forms are depurated. Martin described two scenarios for what happens with Se when it is taken up by brine shrimp: 1) Se-75 that is taken up displaces existing non-radioactive Se in the organism with the net result that the total amount of selenium in the organism is constant, or 2) Se-75 that is taken up is accumulated by organism in addition to the base load. We don't know which occurs.

Bill Adams pointed out that Martin's experiment was completed using classic methodology. Other experiments have not verified the assumption of equilibrium either. It is a reasonable assumption but has not been verified.

Martin explained that Se-75 and selenate are added to a deionized solution. They measured the total Se and Se-75 concentrations to define the ratio of forms of Se in the solution. This solution is what the brine shrimp are placed into. What we do not know is the concentration of Se in the brine shrimp before they were placed into the Se solution. The number of animals he is working with is too small for total Se analysis. Uptake rate is

different than accumulation rate. We can be confident in the uptake rate. Bill Adams agreed.

Consensus was that uptake coefficients are OK.

Martin pointed out that algae were raised in constant presence of Se-75; algae should be representative of that Se concentration. Many other experiments involved adding algae to the Se solution. This is a much different scenario that is not as representative of the conditions in Great Salt Lake and would present a potential problem with uptake coefficients. The method Martin used is consistent with GSL.

Theresa Presser pointed out that the accumulation rate of selenite is typically higher than for selenate. Bill Adams pointed out that Martin's uptake rates were higher than those he and Marge Brooks developed. They used different methods including non-radioactive Se and found they could not measure Se differences in tissue. Martin's method with Se-75 is more accurate, but produces dramatically different results.

Theresa asked if the stock solution had been speciated. It had not. Theresa wondered whether the form of Se could have converted from selenate to selenite during the "shelf-life" of the solution. Martin said that his experiments raise the question of how algae reduce the Se concentration during their growth phase. Speciation may shed some light on that. Theresa thought that existing literature may also shed some light on this question.

Martin pointed out that his bioaccumulation factor is consistent with what is observed in GSL. Bill Adams agreed. Martin said this was the case using his 21-day-old algae that had achieved steady state. The factor was different for algae still in their growth phase and is in fact much larger than previously reported resulting in tissue concentrations of selenium during the growth phase that higher than any previously reported.

It was agreed that the stock solution should be sent to Frontier for speciation and to compare to total Se concentrations measured at Martin's lab. {Note we need to contact Frontier to see if they have a problem receiving a water solution that is slightly radioactive.]

Bill Adams said he would provide Se/algae data from David DeForest to Martin. Theresa asked that Martin look at older work (back to 1976). Martin agreed that these may be good comparisons but there are likely many differences in methods. Martin agreed to look at possible Se transformations and results of previous publications that he had not seen.

Theresa pointed out that the uptake rate from water to brine shrimp seems high. Literature shows that transfer from food to invertebrates is much higher than water to invertebrates (~2-3% of total transfer is from water). Theresa wondered why his experiment seemed to have a high transfer from dissolved Se. She suggested that he look closely at his units and those reported in the literature. Martin said he had reviewed the units specifically with David Buchwalter while they were at a conference in November but would do so again. Theresa said that the common unit is L/g/day.

Bill Adams suggested comparing Martin's uptake rates to work done by EPRI (George Bowie). They likely had similar issues but it is a point of comparison. It may be difficult to acquire this information, but it may be available for purchase from EPRI. Bill also suggested that we plot seston data, brine shrimp data and water data from GSL to compare the slope of Se increases. We really need Brad Marden's data to move forward. Earl Byron joined the

call briefly to describe what his analysis has found. He generally sees a similar increasing trend in seston and brine shrimp. The best and only statistically significant relationship he found was between total Se in water and adult brine shrimp. He had also normalized seston Se concentrations based on chlorophyll and compared those to brine shrimp and found a relationship. Field data do seem to suggest that dissolved Se concentrations dominate transfer to brine shrimp similar to Martin's observations. Harry Ohlendorf suggested analysis of the water, seston, and adult brine shrimp data on a sampling station basis to determine whether there were significant relationships through time.

Depuration constants were discussed. Martin measured a depuration rate. He measured Se-75 but did not measure non-radioactive Se. If non-radioactive Se behaves differently than Se-75, or if the total selenium pool is not accurately assessed using the radiometric measurements then error could be introduced. We would need a large-scale experiment designed to generate sufficient brine shrimp biomass to allow for non-radioactive selenium measurements to answer this question.

Martin confirmed that the lowest Se concentration he used to determine uptake from water to brine shrimp was 1.2 ppb. The Panel asked that he look into a new experiment that evaluates uptake from water with 0.3 ppb; Martin suggested the study also should include 0.6 and 1.2 ppb Se-75 (to link to field-measured concentrations in GSL and the previously tested level). The lower two of these would be more representative of GSL concentrations.

There was consensus that if Martin's work is matching field data, further experiments are not going to add much. Brad Marden's data will help determine this. It was agreed that the water-to-brine shrimp experiment was feasible in the current time frame and would add value.

Action Items

1. Science Panel to forward any further literature and references to Martin for him to review. Martin will review units and information on transformations.
2. Science Panel to forward all written comments to Martin in the next week (by January 18).
3. Brad Marden's data are the critical path to verify Martin Grosell's work. CH2M HILL and UDWQ to contact Brad.
4. Locate the George Bowie publication resulting from the EPRI selenium model work. {I have located the model – I just am not willing to pay to have access to the model].
5. Look at combining water data from Brad Marden and Dave Naftz. How do they compare? What are differences?
6. Earl Byron to summarize his current seston/brine shrimp data set and summarize how he handled the data. Bill Wuerthele asked that he look at individual stations for comparison instead of just the geometric mean.
7. UDWQ, Jeff and Martin to discuss additional experiment.
8. Send stock solution samples to Frontier for speciation and total Se analysis. Compare to Martin's lab results.